Headwater Stream Initiative

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Why are headwater streams important?

- The most prevalent form of stream in the state, with over 115,000 miles estimated to exist (vs. 21,000 miles of named streams).
- Provide habitat for native fauna well adapted to headwater stream conditions.
- Important in the assimilation of pollutants and storage of runoff and flood waters.
- The “capillaries” of the state’s stream network.
Federal Clean Water Act

- The Clean Water Act provides authority for states to issue water quality standards and “designated uses” to all waters of the United States upstream to the highest reaches of the tributary streams.

  - Source: Memorandum dated January 19, 2001, General Counsels of USEPA and US Army corps of Engineers
Ohio rules require all water bodies to have designated uses. [OAC 3745-1-01, OAC 3745-1-07 (A)(1)]

Current stream use designations are inadequate to classify small headwater streams.

Since 1999 research has been conducted to determine appropriate methods for classifying headwater streams.

Data will be used to propose new aquatic life use designations for “primary headwater habitat” streams in Ohio.
Primary Headwater Habitat Streams

- Generally < 1 mi$^2$ watershed area and pools less than 40 cm in depth.

- “Primary headwater habitat” term is used to distinguish from “headwater” fish streams in current use designations (<20 mi$^2$).

- Primary headwater habitat (PHWH) streams are incapable of supporting well balanced communities of fish because of their small size and lack of deep pools.
Where have the streams gone?

Mill Creek
Early 1900’s
Where have the streams gone?

Source: Cuyahoga SWCD
Desktop Headwater Stream Identification

- USGS
  1: 24,000
  Topographic Mapping Scale
  0.68 sq. mi.
Desktop Headwater Stream Identification

- NRCS Soil Map including hydro-layer

Scale Range = 1:15,000 to 1:20,000

Watershed from previous USGS slide
Primary Headwater Stream (PHWH) Evaluation Methodologies

- An evaluation protocol for PHWH streams was developed in 1999.

- A total of 305 sites were sampled by the Ohio EPA in 1999-2000. Quarterly biological monitoring of reference sites was also conducted.

- Randomized sampling of five geographic areas was conducted in 2000 to estimate the distribution of different types of headwater streams in the state.
PHWH Survey Sites 1999-2000

Stream Class
- Class I
- Class I Mod
- Class II
- Class II Mod
- Class III

County Boundaries

- Western Allegheny Plateau
- Interior Plateau
- Huron Erie Lake Plain
- Erie Ontario Lake Plain
- Eastern Corn Belt Plains
Study Design: Field Evaluation

- **Biology:**
  - Fish
  - Macroinvertebrates
  - Amphibians

- **Water Quality:**
  - Field measures
    (DO, pH, Temp., Conductivity)

- **Physical and Habitat Features:**
  - 200 foot zone
PHWH Stream Assessment Results

- Sampling of randomly chosen sites used to estimate the miles of various stream categories.

- Ratio of PHWH streams to streams delineated on USGS topo maps = 5.5:1

 Total for PHWH Streams = 115,206 mi (69.0%)
Class I PHWH Streams

- **Ephemeral Flow.** Dry channel present annually.
- **Aquatic life absent or present seasonally - low diversity.**

Natural channel, Geauga Co.  
Modified channel, Delaware Co.
Class II PHWH Streams

- Warmwater adapted community.
- Flow may be intermittent.
- Permanent pools present annually.

Modified channel, Delaware Co.  
Natural channel, Geauga Co.
Class III PHWH Streams

- Perennial flow.
- Presence of one or more of the following at all times:
  - Obligate aquatic salamanders
  - Cold water or pioneering fish species
  - Cool water adapted benthic macro-invertebrates.

Delaware Co.
- Salamanders replace fish as the top vertebrate predator in primary headwater streams.

- Shredder functional group of benthic invertebrates is most common in primary headwater streams.
Results: Benthic Macroinvertebrates

Two distinct macroinvertebrate communities:

- Class III: n=46
- Class II: n=29
- Class I: n=10
Results: Headwater Macroinvertebrate Field Evaluation Index (HMFEI)

- Rapid field assessment methodology based upon Family or Order level of taxonomy.
- Scoring based upon correlation to cool water habitats and number of EPT taxa present.
- HMFEI is a surrogate. Final use class based upon identification to species level.
Class III-PHWH Streams: Presence of Obligate Salamanders and/or Cold Water Fish

- Cold water adapted species of fish and/or salamanders are found in Class III headwater streams.
Salamanders Found in Headwater Streams in Ohio

Class III Streams
(Gilled larvae present on annual basis)
- Plethodontidae (Lungless)
- Subfamily Plethodontinae:
  - Gyrinophilus (2 species)
  - Pseudotriton (2 species)
  - Eurycea (4 species)

Class II Streams
(Gilled larvae present seasonally)
- Ambystomatidae (Mole)
  - Ambystoma spp.
- Plethodontidae (Lungless)
- Subfamily Desmognathinae:
  - Desmognathus (2 species)
Distribution of Class III PHWH Indicator Salamander Species

- No Class III Indicator Species
- Range of Class III Indicator Species
Two-Lined Salamanders

Range of Class III Indicator Species

Eurycerus bislineata
Eurycerus cirrigera

No Class III Indicator Species

Range of Class III Indicator Species
Cave Salamander

*Eurycera lucifuga*

- **Range of Class III Indicator Species**
- **No Class III Indicator Species**
Longtail Salamander

Range of Class III Indicator Species

No Class III Indicator Species

Eurycerus longicauda longicauda

W

S

60 0 60 120 Miles

Range of Class III Indicator Species

No Class III Indicator Species

Eurycerus longicauda longicauda
Mud Salamander

Pseudotriton montanus

- No Class III Indicator Species
- Range of Class III Indicator Species
Red Salamander

Range of Class III Indicator Species

Pseudotriton ruber

No Class III Indicator Species

Range of Class III Indicator Species
Spring Salamanders

- Gyrinophilus porphyriticus duryi
- Gyrinophilus porphyriticus porphyriticus

Legend:
- Red circle: Gyrinophilus porphyriticus duryi
- Yellow circle: Gyrinophilus porphyriticus porphyriticus
- No Class III Indicator Species
- Range of Class III Indicator Species
<table>
<thead>
<tr>
<th>Species</th>
<th>Relative No. (%)</th>
<th>Pioneering Species</th>
<th>IBI-Headwater Species</th>
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<tr>
<td>Creek Chub</td>
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<td>No</td>
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<tr>
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<td>13 (19.4)</td>
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<td>Blacknose Dace</td>
<td>7 (10.4)</td>
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<td>Johnny Darter</td>
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<tr>
<td>Stoneroller Minnow</td>
<td>3 (4.5)</td>
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<td>Largemouth Bass</td>
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<td>Mottled Sculpin</td>
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<tr>
<td>Orangethroat Darter</td>
<td>1 (1.5)</td>
<td>Yes</td>
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</tbody>
</table>

Fish species in **bold** represent primary HWH stream indicator native species based on habitat preference.
25 Most Common Fish Species in Primary Headwater Streams (< 1 sq. mi) from Ohio EPA Electrofishing Surveys (N=212 Sample Events from 144 Streams)

- Creek chub
- Blacknose dace
- Green sunfish
- White sucker
- Stoneroller minnow
- S. Redbelly dace
- Bluntnose minnow
- Bluegill sunfish
- Fathead minnow
- Largemouth bass
- Johnny darter
- Fantail darter
- Yellow bullheads
- Silverjaw minnow
- Orangethroat darter
- Striped shinner
- Mottled sculpin
- Brook stickleback
- Rainbow darter
- Golden shinner
- Central mudminnow
- Spotfin shinner
- Grass pickerel
- Redside dace
- Brown trout

Proportional Occurrence
Stream Water Temperature

Seasonal Differences in Water Temperature Between Class III and Class II-I
Primary Headwater Streams in Ohio
(Excluding Northwest Ohio Modified Streams)
A Headwater Habitat Evaluation Index (HHEI) was developed to provide a rapid assessment tool to predict PHWH stream classes.

Data from 213 sites state-wide was used to develop the index.

The approach was similar to that used to develop the QHEI, an index of fish habitat quality in use in Ohio for over 20 years.
The Headwater Habitat Evaluation Index (HHEI): Metrics

<table>
<thead>
<tr>
<th>Initial Data Set</th>
<th>Qualitative Screening</th>
<th>Discriminant Analysis</th>
<th>Sensitivity Analysis: Final Metrics</th>
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</tbody>
</table>
The Headwater Habitat Evaluation Index (HHEI): Metrics

Final HHEI based on three metrics:

- **Substrate Metric (40 points)**
  - Based upon predominant channel substrate types and the number of substrate types present.
- **Bankfull Width (30 points)**
  - Based upon average bankfull width.
- **Maximum Pool Depth (30 points)**
  - Based upon a single measure of maximum pool depth.

Total HHEI Score ranges from 0 to 100
Substrate Metric Scores

Natural Channels

Modified Channels
Bankfull Width Metric Scores

Natural Channels

Modified Channels

Class III  Class II  Class I  Class II Mod  Class I Mod

Bankfull Width Metric Score
Pool Depth Metric Scores

Natural Channels

Modified Channels

Class III

Class II

Class I

Class II Mod

Class I Mod
Total HHEI Scores

HHEI Score (100 pts. max)

Class III | Class II | Class I | Class II Mod | Class I Mod

Natural Channels

Modified Channels
Use of the HHEI to Predict Headwater Stream Classification

- Protect as Class I
- Protect as Class II
- Apply Substrate Filter
- Protect as Class III
Advantages to HHEI Approach

- Provides rapid assessment which can be conducted in 15-20 minutes.
- Provides immediate insight into stream classification.
- Can be learned with minimal training.
- Does not require rigorous biological evaluation.
- Can be conducted at any time of the year.
- Independent of factors which are not within OEPA’s regulatory authority.
Three-Tiered Evaluation Approach

- 1st Tier: HHEI scoring and flow chart (required for all sites)

- 2nd Tier: Rapid bio-assessment using HMFEI (common)

- 3rd Tier: 10 meter salamander survey, fish survey, macroinvertebrates identified to species (very rarely needed)
Low gradient headwater streams. Dry for much of the year. Little biological potential.

CLASS I

Transitional headwater streams with permanent pools. Macro-invertebrate community but no obligate vertebrates.

CLASS II

Perenial headwater streams with obligate vertebrate community. Cool water macro-invertebrates.

CLASS III

Streams supporting a well balanced fish community. Drainage area < 20 sq. miles. Headwater IBI scoring.

Streams

Drainage area > 200 sq. miles.

Small rivers (drainage area < 200 sq. miles).

Large rivers (drainage area > 200 sq. miles).

Lacusuary scoring for Lake Erie river mouths.

Proposed HWH Use Designations

Existing Aquatic Life Use Designations

Proposed Lacusuary Criteria
What we are losing ...........

1999

Unnamed Class III tributary to Tinkers Creek HHEI Score = 55

2001